NORTHERN FOREST EXPERIMENT STATION
JUNEAU, ALASKA
U. S. DEPARTMENT OF AGRICULTURE

U. S. FOREST SERVICE

RESEARCH NOTE NOR-19

December 1966

SPECIFIC GRAVITY OF INCREMENT CORES FROM INTERIOR ALASKA TREES

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Specific gravity or density is a basic wood property that is used as an indicator of pulp yields, strength characteristics, workability, and weight. The ability to adequately describe wood as a raw material is becoming increasingly important to industry in evaluating economic opportunities. One source of wood density information is the small diameter increment cores which foresters collect from trees for age and growth information. Although a core taken at breast height may not represent the average density of all the wood in a tree, the tree average density and the core density are usually highly correlated.[1]

Specific gravity analysis is summarized in table 1 for cores collected from 1,065 sample trees during the initial forest inventory of interior Alaska. The locations were randomly selected over the commercial forest lands of interior Alaska, including roughly all of the mainland to the north or west of Anchorage. From 1 to 10 trees of a species could have been selected at a single location, depending upon stand composition.

[1] Wahlgren, Harold E., and Fassnacht, Donald L. Estimating tree specific gravity from a single increment core. U. S. Forest Serv., Forest Prod. Lab. Rep. 2146, 24 pp., illus., 1959.

Trees selected were the nearest growing-stock tree (Forest Survey standard for merchantable tree), 5.0 inches d.b.h. (diameter at breast height) or over, within 33 feet of each of 10 points systematically spaced over a 1/2-acre location (1X5 chains). One core was taken at d.b.h. and to tree center when possible. The increment borers used were 12 inches in length and averaged about .170 inches inside diameter.

The procedure for obtaining the specific gravity of increment cores is described by Taras and Wahlgren.[2/] Green volume was computed using the borer diameter and green core length. After drying in a convection oven at 105° C. for approximately 48 hours, each core was weighed to the nearest .001 gram. Specific gravity was calculated by dividing oven-dry weight (grams) by green volume (cm^3).

Statistical analysis of the data shows reasonable error values (table 1) for specific gravity samples distributed over a large area. Average specific gravity values from table 1 are compared with averages from other sources in table 2. Generalized conclusions based on these tables should be drawn with care. For most other sources, error information is not available, and specific gravity values may be tree average although the most common basis is lumber samples or tree sections. Many values are based on samples from a small number of geographic locations and may not reflect the true regional average. Also, while the core densities are likely to be correlated with tree averages values, the nature of this correlation for interior Alaska tree species is not known.

Cursory examination of the data indicates that a longitudinal gradient may result in higher densities in a westward direction. As shown in table 2, specific gravity values from the Alaska increment cores tend to be as high or higher than those reported from other sources. Weather and soil factors, including permafrost, in interior Alaska cause slower growth than in many other areas within the ranges of these species. This could be indicative of significantly higher specific gravity values in Alaska than generally accepted species averages. Conclusive results can only come from additional work.

2/ Taras, M. A., and Wahlgren, H. E. A comparison of increment core sampling methods for estimating tree specific gravity. U. S. Forest Serv. Res. Paper SE-7, 16 pp., 1963.

Table 1.--Average specific gravity of increment cores by species from interior Alaska trees

Species	Number of cores	Number of locations	Mean specific gravity 1/	Standard error 2/
Sitka spruce 3/ (*Picea sitchensis*)	16	2	.400	.011
Black spruce (*Picea mariana*)	77	23	.423	.004
White spruce (*Picea glauca*)	567	103	.400	.002
Quaking aspen (*Populus tremuloides*)	74	22	.374	.004
Paper birch (*Betula papyrifera*)	296	78	.508	.003
Balsam poplar 4/ (*Populus balsamifera*)	35	11	.345	.008

1/ Oven-dry weight/green volume basis.

2/ Although several cores were usually collected at each location, each core was considered an independent observation, and the sample means and standard errors were calculated as follows:

$$\text{Sample mean} = \sum y_i / n$$

$$\text{Standard error} = \sqrt{S^2 / n}$$

$$\text{where:} \quad S^2 = \frac{n\left[\sum y_i^{\,2}\right] - \left[\sum y_i\right]^2}{n[n-1]}$$

n = number of cores $\qquad y_i = i^{th}$ core specific gravity value.

3/ Cook Inlet area only.

4/ May contain samples of black cottonwood (*Populus trichocarpa*) from the Cook Inlet area.

Table 2.--Average specific gravity comparisons

Species	Alaska increment cores	Alaska 1/	Wood handbook 2/	Canada 3/	Canada 4/
Sitka spruce (*Picea sitchensis*)	.40	.39	.37	.35	.35
Black spruce (*Picea mariana*)	.42	--	.38	.40	.41
White spruce (*Picea glauca*)	.40	.39	.37	.34	.35
Quaking aspen (*Populus tremuloides*)	.37	--	.35	.38	.37
Paper birch (*Betula papyrifera*)	.51	.49	.48	.51	.51
Balsam poplar (*Populus balsamifera*)	.34	.30	.30	.37	.37

1/ Markwardt, L. T. The distribution and mechanical properties of Alaska woods. U. S. Dep. Agr. Tech. Bull. 226, 80 pp., illus., 1931.

2/ Forest Products Laboratory. Wood handbook. U. S. Dep. Agr. Handbook 72, 528 pp., illus., 1955.

3/ Rochester, G. H. The mechanical properties of Canadian woods. Can. Forest Serv. Bull. 82, 88 pp., illus., 1933.

4/ Kennedy, E. I. Strength and related properties of woods grown in Canada. Can. Dep. of Forestry Publication No. 1104, 51 pp., 1965.